

Global

Ocean

Observing

System



Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

IOC-WMO-UNEP-ICSS Coastal Panel of the Global Ocean Observing System (GOOS)

Fifth Session
Gdansk, Poland
2-6 May 2000

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Abstract

This report presents a summary of the topics discussed at the fifth and last session of the Panel, whose broad objectives is to develop the coastal element of the Global Ocean Observing System. The goal of the meeting was to finalize the C-GOOS Strategic Design Plan. Background information was provided regarding the following: Remote sensing requirements; Bathymetric requirements for robust forecasts; The Mediterranean Forecasting System; The Baltic Operational Oceanographic System; The Global Coral Reef Monitoring Network; and the Ramsar Convention on Wetlands. A report of a 1-day Stakeholders' workshop held in connection with the panel meeting is also provided. The Strategic Design Plan is expected to be completed by October 2000 following external review.

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1. OPENING

The fifth session of the Coastal Panel of GOOS (C-GOOS) was opened at 0900 on 2 May, 2000 by Tom Malone who introduced Professor Aleksander Kolodziejczyk, Rector of the Technical University of Gdansk. He warmly welcomed the panel and the stakeholders and expressed his wishes for a successful meeting. Professor Jacek Namieśnik, Dean of the Chemical Faculty and Chairman of the Local Organizing Committee, also welcomed the panel and guests and hoped for a productive session.

Thorkild Aarup welcomed participants on behalf of the Executive Secretary of the Intergovernmental Oceanographic Commission (IOC) and on behalf of the sponsors of GOOS: IOC, World Meteorological Organization (WMO), United Nations Environment Programme (UNEP), and the International Council for Science (ICSU). He thanked the US. National Oceanic and Atmospheric Administration (NOAA), the Government of Holland, the Office of Naval Research, the Norwegian Research Council. He also thanked Jacek Namieśnik, for all the hard work he and his staff had done in preparation of the meeting, and the Chemical Faculty for providing financial and logistic support of the meeting.

2. PANEL MEMBER REPORTS

2.1 C-GOOS V STAKEHOLDERS' MEETING

A meeting of stakeholders was organized in connection with the fifth session of the Coastal-GOOS Panel at the Technical University of Gdansk, Poland on 2 May 2000. The main objective of the meeting was to discuss various needs of stakeholders in the Baltic Sea region with focus on needs for an accurate and complete observation system. This session was chaired by Jacek Namiesnik and Jozef Pacyna.

In order to meet the above mentioned objective, the meeting participants discussed the external forcing on the coast of the Baltic Sea and its consequences. The pace and extent of change of this coast is controlled by an increasingly complex set of bio-geo-chemical and socio-economic interrelationships and feedbacks. A need for continuous observation and analysis of environmental changes in the Baltic was emphasized in this context.

In the first presentation, Tom Malone outlined the goals and objectives of the Coastal GOOS Panel. He briefly presented major parts of the Strategic Design Plan for the coastal component of GOOS and explained that the primary goal of C-GOOS V is to complete a rough draft of the Design Plan.

Marcin Weslawski and Andrzej Lewandowski presented the goals and structure of the Polish Scientific Committee on Oceanic Research (SCOR). Polish SCOR consists of five sections, including the newly established Section of Operational Oceanography. In the following presentation Juliusz Gajewski described current status and future plans of the Info-BOOS, the information system for the Baltic Operational Oceanographic System (BOOS). Info-BOOS was established with the aim to improve services for users of the GOOS results. A few examples of user-oriented applications operated by BOOS partners were given.

The next presentations focused on the socio-economic drivers of the environmental change in the coastal zone of the Baltic Sea and their environmental consequences. Coastal problems in Poland were discussed by Andrzej Cieslak and Marcin Weslawski. Mirosław Boruszcak described the impact of tourism on the Baltic coast, while Reinhold Wawrowski discussed the problem of coastal erosion in the region. An interesting programme on the impact of tourism on the

biodiversity (the LITUS project) was described by Marcin Weslawski. The government's programmes to mitigate the effects of human activities were described by Danuta Grodzicka-Kozak.

Presentations were given on observing networks for the Baltic Sea and procedures used to quantify environmental change. Boris Chubarenko presented the main aspects of monitoring of the Baltic sea and the Kaliningrad coastal zone. Viatcheslav Gordeev described the Land-Ocean Interactions in the Russian Arctic (LOIRA) programme intended to evaluate these interactions. Piotr Szefer outlined the monitoring of heavy metals in the Southern Baltic ecosystem. Boguslaw Buszewski focused on new analytical methods applied in the analysis of various chemicals in water samples, especially methods for organic compounds. Alexie Nekrasov described the monitoring system of the Baltic Sea and its coastal zone within the IOC/UNESCO sponsored Baltic Floating University programme. Finally, Georgij Ivanov commented on various environmental aspects of monitoring of the Baltic Sea.

The chairmen summarized the discussion which focused on the relationships between the socio-economic drivers causing environmental changes in the coastal zone. The pressures related to these drivers, their environmental and socio-economic impacts, and the importance of the implementation of an observing system that provides the data and analytical capabilities required to detect, and predict these impacts. It was pointed out that stakeholders would have a variety of diverse needs and expectations that would have to be considered in design and implementation.

2.2 C-GOOS PRESENTATIONS AT COASTAL CONFERENCES

Julie Hall gave an invited talk on C-GOOS at the International Coastal Symposium 2000, the theme of which was "Challenges for the 21st Century in Coastal Science, Engineering and Development" in Rotorua, New Zealand. She stressed that there is an important task for the panel in educating the scientific community on the C-GOOS concept. Tom Malone commented that he had observed a big turn-around in the support of GOOS over the past year. He also emphasized the need to promote C-GOOS at the local and regional level.

Eduardo Marone attended the 4th Land-Ocean Interactions in the Coastal Zone (LOICZ) Open Science Meeting, in Bahia Blanca, Argentina where he also gave a presentation on C-GOOS. He stressed the importance of maintaining the linkage between C-GOOS and LOICZ and mentioned that many regional LOICZ projects have the potential to become C-GOOS pilot projects.

Discussion emphasized the importance of panel members continuing to inform the scientific community of status of the design and implementation of C-GOOS. It was pointed out that there is a need for promotional material on C-GOOS (flyer/brochure; power-point presentations; C-GOOS poster). Eduardo Marone suggested for the GOOS Project Office to establish a small set of C-GOOS Power Point presentations and a poster. **Julie Hall offered to develop an electronically portable poster.**

2.3 CAPACITY BUILDING

Eduardo Marone, the C-GOOS representative on the GOOS Capacity Building Panel chaired by Geoff Holland, circulated a draft of the GOOS Capacity Building Programme Implementation Strategy (http://ioc.unesco.org/goos/Implementation_Strategy.doc). C-GOOS was mentioned in a number of the suggested activities.

2.4 EuroGOOS/ICES WORKSHOP ON "BIO-ECOLOGICAL OBSERVATIONS IN OPERATIONAL OCEANOGRAPHY" AND THE FIFTH SESSION OF THE INTERGOVERNMENTAL PANEL ON HARMFUL ALGAL BLOOMS.

Adriana Zingone represented C-GOOS at the EuroGOOS/ICES Workshop on "Bio-ecological Observations in Operational Oceanography" (3rd EuroGOOS Scientific Advisory Working Group Workshop) 6-8 April 2000, The Hague, Netherlands where she gave a talk on Harmful Algal Blooms (HABs). The meeting gathered 30 European participants from different fields of interest, with the aim of providing suggestions to EuroGOOS regarding the implementation of biological observations in the European observing system. The meeting included presentations on the biological variables that should be monitored to detect and predict HABs, relevant methods of observation, analysis and modelling, available technology and management perspectives. Observing system requirements were discussed in the following areas: (i) nutrients/primary producers, (ii) secondary producers, (iii) oceanographic context for biological observations and (iv) the general problem of coastal eutrophication. It is expected that EuroGOOS will make specific recommendations in the near future.

Adriana Zingone also reported on the fifth session of IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) which met in Paris from 22-24 November 1999. This panel was formed in 1991 to identify adequate resources for a broad international programme to improve the detection and prediction of HABs and their effects. The Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB), a joint programme of SCOR and IOC, has been established to address these issues. The science plan for GEOHAB has been published which includes a section on the need for regional observing systems.

The goal of GEOHAB is to improve the prediction of HABs by determining the ecological and oceanographic mechanisms underlying the population dynamics of harmful algae. The research question to be addressed include the following: (i) What are the environmental factors that determine the changing distribution of HAB species, their genetic variability and the biodiversity of associated communities? (ii) What are the unique adaptations of HAB species that determine when and where they occur and the extent to which they produce harmful effects? (iii) What are the effects of increasing human activities (e.g., eutrophication, translocation of species) on the occurrence of HABs? (iv) How do HAB species, their population dynamics and community interactions respond to changes in their environment?

GEOHAB is organized in five Programme elements. They are (i) Biogeography and biodiversity (global extent of toxic events and mechanisms of dispersion); (ii) Adaptive strategies; (iii) Eutrophication (sources, pathways, transformation, and impacts of nutrients inputs as related to the population dynamics of HABs); (iv) Ecosystem processes (identify common mechanisms underlying HAB population and community dynamics across ecosystem types through comparative studies); and (v) Observation, modelling, and prediction of HABs. More information GEOHAB can be found at (<http://www.jhu.edu/~scor/GEOHAB.html>).

2.5 HABITAT COMMITTEE

The joint C-GOOS-Living Marine Resources (LMR) *ad hoc* committee on habitat chaired by John Ogden submitted the following report on "Sustainable Use of Coastal Marine Resources, The Role of C-GOOS":

2.5.1 The Challenge to Coastal GOOS

The coastal ocean and continental shelf are the focal point of increasing attention and concern as the meeting place of the three great provinces of land, sea, and air. These regions of shallow water (to 200 m depth) while small in comparison to the adjacent ocean and young in geological age are disproportionately important in terms of biodiversity, biological productivity, and concentration of marine resources. They are also disproportionately vulnerable to human disturbances.

Coastal regions of the world are experiencing explosive population growth through population growth and changing demographics. The pressures on shallow marine ecosystems to provide commerce, recreation, and resources and to receive, process, disperse, and dilute the effluents of a complex modern human society are increasing. With the exception of ownership, human societies use shallow continental seas in much the same way as we use the land and the conflicts in the coastal ocean between commerce, recreation, development, resources exploitation, and conservation are expensive, contentious, politically sensitive and very familiar.

2.5.2 Who is Watching the Coastal Ocean?

There is abundant and increasing evidence of damage and destruction of coastal habitats all over the world from a remarkably short list of human disturbances including: (i) Poor land use practices (point and non-point runoff, sedimentation, nutrient and toxics pollution, dredging); (ii) Fishing and mariculture; and (iii) Global climate change (ocean warming and sea level rise).

There is also growing evidence of synergies of these stresses in, for example, emerging marine diseases, harmful algal blooms, phase shifts in coastal ecosystems, and coral bleaching, to name just a few. Governments all over the world are deeply concerned at these manifest changes in coastal systems and are responding to pressure to understand and to manage human disturbances for the long-term health and productivity of coastal ecosystems. This is the challenge to C-GOOS: to design an observing system that will allow reasonable assessment of long-term trends in coastal habitats and guide the efforts of governments and coastal managers to sustain and restore them.

2.5.3 Coastal Fisheries as an Example: Essential Fish Habitat (EFH)

A key element in achieving sustainable fisheries is the identification, conservation, and restoration of fish habitat. Healthy habitat is a basic requirement for the reproduction, growth, migration, and livelihood of sustainable fishery stocks. Essential Fish Habitat (EFH) may be defined as those waters and substrate necessary for spawning, feeding or growth to maturity and includes the associated physical, chemical, and biological properties that are used by fish and are necessary to support a managed level of fish biomass production.

The management of commercial fishery resources has historically focused on single species and concentrated on assessing stock size and controlling fishing mortality. However, the EFH concept is based on an ecosystem approach to comprehensive fisheries management and includes the conservation and management of fishery habitat as important elements. However, for most species, present knowledge is poor about what habitat must be included in identifying EFH. Accurately delineating the EFH of a fishery species, or a particular life stage, will require detailed and comprehensive assessment of where these animals live along with the associated marine environmental conditions.

A sizable proportion of commercial coastal pelagic and demersal fish stocks are dependent at some stage of their lives on estuaries in addition to coastal waters. For example, estuarine wetland areas are EFH for many fishery species that live and spawn in coastal waters and have young that migrate into estuarine nursery grounds where they grow into subadults. The EFH characteristics for demersal fishery species in coastal and open ocean waters often include structure, hydrodynamics and general hydrology. The EFH for pelagic species in both the coastal and open ocean waters is often linked to dynamic oceanographic characteristics, features, processes, and structures. In tropical areas, coral reefs and related environments form EFH for many fishery resources. Anadromous fish species, such as salmon, have EFH requirements in marine waters, as well as, in freshwaters.

A key element in the EFH process is the identification of existing and potential threats to habitat and the conservation and enhancement measures necessary to eliminate or minimize these threats. The nature and extent of particular threats to EFH will vary by region and usually depend on habitat type, exposure, and other environmental variables. Habitat degradation, e.g., destruction of wetlands, eutrophication, harmful algal blooms, and direct degradation or alteration of the environment, is a critical threat to EFH.

The FAO asserts that nearly global fishing regions are either fished to capacity or over-fished. Fishing affects coastal marine habitats in a variety of ways. Some fishing gears, for example trawls, directly damage habitat and repeated trawling prevents any reasonable recovery. The degree to this damage is repeatedly visited on the bottom in certain regions where trawl fishing is intense is truly alarming. It is clear that removal of target species of fishes, in many cases top carnivores, can have destabilizing effects on lower trophic levels. This indirect disturbance has been hypothesized as the cause of the phase shift on coral reefs from corals to benthic algae. In the temperate zone, the removal of cod from the northeastern U.S. and Canada has changed the trophic structure of benthic and pelagic ecosystems.

The capacity of fishing activity to damage coastal habitats to the potential long-term detriment of coastal ecosystem functioning has driven the development of the concept of Essential Fish Habitat (EFH). The U.S. Congress defined EFH in the Magnuson-Stevens Fishery Conservation and Management Act of 1996 as: *"those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."* Under U.S. law, the definition for EFH may include habitat for an individual species or an assemblage of species; whichever is appropriate within a particular fishery management plan.

The concept of EFH acknowledges that fishes depend upon habitat. At a basic level, habitats provide food and shelter and fish use of habitat often shifts with ontogeny. For example, many coral reef fishes are found in mangrove and seagrass nurseries and spend their adult lives on coral reefs. Pacific coast salmon and other anadromous species use coastal estuaries and wetlands during the critical transition between larval life in streams and adult life in the open ocean. Obviously, any of these habitats if damaged or disturbed can be a critical bottleneck with respect to the long-term exploitation or even survival of a species. EFH is obviously a much broader concept than this, implicitly accepting the critical nature of physical, chemical, and biological linkages between the coastal ocean and open ocean as well as the land.

Mariculture of shrimp and fishes has proven to be extraordinarily damaging to shallow coastal habitats. For example, it is estimated that approximately 50% of the coastal mangrove forests of the world have been lost, mostly to mariculture ponds. Some countries, such as Thailand and Indonesia, are attempting to restore mangrove forests, but the pollution and toxic materials left in the sediments after intensive mariculture make this a very difficult proposition.

While specifically in reference to fisheries, EFH is congruent with the habitat component of biological diversity, and like biodiversity it is essentially an unknowable entity. All of the ecosystem functions listed in Table 1 contributing critical services to human populations do the same thing for fish populations. Therefore, sustained yield of fisheries requires preservation of the health of the entire system. In this context, health can be defined as the ability of the resource to renew itself.

Table 1. Ecosystem services provided by coastal aquatic ecosystems in rank order of estimated value (adapted from Costanza, R. *et al.* 1997: The value of the world's ecosystem services and natural capital. *Nature*, 387: 253-260.).

Rank	Ecosystem Service	Ecosystem Functions	Examples
1	Nutrient Cycling	Nutrient storage & processing	N fixation, nutrient cycles
2	Waste Treatment	Removal, breakdown of excess nutrients & contaminants	Pollution control, detoxification
3	Disturbance Regulation	Buffer impact of climatic disturbances	Storm protection, flood control, drought recovery
4	Recreation	None	Boating, sport fishing, swimming, etc.
5	Food Production	Portion of PP extractable as food	Fish harvest
6	Refugia	Habitat, biodiversity	Nurseries, resting stages, migratory species
7	Cultural	None	Aesthetic, artistic, spiritual, research
8	Biological Control	Trophic dynamics, biodiversity	Keystone predator, pest control
9	Raw materials	Portion of PP extractable as raw materials	Lumber & fuel
10	Gas Regulation	Chemical composition of the atmosphere	CO ₂ , O ₃ , SO _x

2.5.4 The Precautionary Principle, EFH, and Fisheries Management

The 2 February, 2000 European Commission Communication notes:

"The precautionary principle applies where scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen by the EU."

This statement echoes the 1992 Rio Declaration on Environment and Development:

"Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

As the precautionary principle has been elaborated recently, it nearly always implies three additional ideas, beyond "harm" and "scientific uncertainty":

- The notion of seeking alternatives to harmful technologies;
- The idea of shifting to proponents of a technology the responsibility for demonstrating its safety; and
- The goal of transparency and democracy in making decisions about technologies.

Given the essentially unknowable nature of EFH (coastal biodiversity) and its interaction with exploited fish populations, the precautionary principle provides a sound approach to assessing and making decisions on fisheries management. We make our decisions with the best possible information on risks and benefits, consider alternatives, choose the best and safest alternative, and hold fishers responsible. In the face of insufficient information, when EFH or a fish stock is threatened, we tend to take steps to err on the side of caution.

2.5.5 The Exclusive Economic Zone (EEZ): EFH and Marine Protected Areas

The concept of EFH combined with the emergence of the precautionary principle in guiding decision-making in environmental management have lent great credence to the idea of zoning the coastal marine environment through the use of marine protected areas (MPAs). Various types of MPAs, particularly those incorporating *no-take marine reserves*, have captured the imagination of scientists, resource managers, fishers, and the general public as a simple, understandable, and demonstrably effective way of protecting marine resources and biodiversity. For example, the Great Barrier Reef Marine Park, the largest and the most comprehensive marine protection scheme in the world, is a MPA which uses zoning including fishing prohibition areas to separate potentially conflicting human activities. The Florida Keys National Marine Sanctuary is one of the largest and most complex MPAs in the U.S. The no-take marine reserves were the most contentious element of its comprehensive management plan. However, even taking their relatively large size into consideration these MPAs with their reserves are still too small to encompass and protect EFH.

The Exclusive Economic Zone (EEZ) provides a logical, legally defensible, and ecologically meaningful geographic area in which comprehensive management and protection has the best chance to achieve sustainable balance of resource use and conservation. For example, in the U.S. the Magnusen-Stevens Act with its emphasis on Essential Fish Habitat (EFH), marine ecosystems, and the precautionary approach based on scientific information, contains essential elements of such a broad approach. The 9 Fisheries Councils, guided by the Act, are already making resource policy within the EEZ. Thus it is a *de facto* country-wide MPA.

Carrying this line of thought further, the concept of MPAs brings one of the most familiar tools that we have used on land to separate potentially conflicting human activities and uses, that of the *Landscape (or Land-Use) Plan* and zoning, into the sea. Within the EEZ, we have the opportunity to step back and assess with the best available knowledge the distribution of and threats to coastal ocean biodiversity (EFH). The data and information to do this is abundantly available from federal, regional and state sources. Armed with this information we can implement a process leading to a *Seascape (or Ocean-Use) Plan*, based upon comprehensive zoning within the EEZ, that will start us along a whole new course of protection and use of our coastal marine resources.

This approach has several immediate benefits. First, it is familiar and can be put into positive terms unlike, for example, no-take marine reserves. If restricted zones are nested within an Ocean-Use Plan in which the goal is to sustain most existing human uses, it becomes a positive planning exercise in which all can have a role. Second, the Ocean-Use Plan logically links the coastal ocean to the land and to the open ocean, a goal that is often stated as basic to coastal ocean management, but which is rarely achieved. Finally, a key difference between land and sea is that zoning in the sea is inherently more flexible. The ocean isn't owned and zones can be established and moved in

response to increased understanding and changing exigencies. In other words, adaptive management of the coastal ocean will be inherently easier than on land.

The EEZ encompasses much of our marine biodiversity and the myriad physical, chemical, and biological linkages which C-GOOS must address. Yet, only in a few cases are these linkages known and thus the extent of protection required is controversial. The geographically broader approach and the potential flexibility of an Ocean Use Plan help to deal with the vexing question: How much of a larger area zoned for multiple uses should be protected from all human disturbances? The figure of 20% has been widely discussed, but we must acknowledge that there is very little scientific justification for it. It evolved as a practical matter. It seems to be big enough to provide significant protection yet it is not so big as to be politically impossible to achieve. If we continue business as usual, the point may be moot, as built up one reserve at a time, our recent practical experience shows us that we will have great difficulty in even getting close to 20%. However, visualized within a scheme of comprehensive protection based upon zoning, significant protection can be supported as in balance with traditional human uses.

2.5.6 The Role of Coastal GOOS

There is a great opportunity for the GOOS programme to make vital contributions to global fisheries management, understanding of EFH and coastal biodiversity, and ultimately the development of MPAs by providing critical information on marine environmental variability on which human disturbance is superimposed. The discrimination of human disturbances from natural variability is one of the great challenges facing our attempts to manage human disturbance for the sustainable use of coastal marine resources. The monitoring schemes adopted must employ and later integrate both *in situ* and remote sensing techniques.

Physical Monitoring

Coastal meteorological and oceanographic monitoring is as basic to understanding and managing coastal ecosystems as the chart. Seasonality of temperature, salinity, and wind conditions are the drivers of biological processes such as productivity and recruitment. Coastal winds are the primary forcing for currents, which link broad regions through transport of larvae and also define the nature and scale of coastal pollution. We are entering an era when global climate change will be a predominant concern in the coastal ocean. For example, temperature rise with attendant stresses on coastal populations will begin to cause shifts in distributions and perhaps community and ecosystem changes. Accelerating sea level rise will change the coastal seascape, particularly by shifting or even eliminating shallow coastal features such as estuaries, coastal mangrove forests, shallow seagrass beds, and even offshore features such as coral reefs.

Chemical Monitoring

Studies in the terrestrial environment suggest a doubling in atmospheric injection of nitrogen in the past 20 years. It is known that the amount of nitrogen delivered to coastal waters by major rivers has greatly increased over the same interval. A major contribution of C-GOOS will be to apply the new techniques of *in situ* nutrient monitoring to encompass the scale of physical linkages so that the sources and areas affected by excessive nutrients may be delineated. Along with nitrification, pollution by myriad toxic materials including heavy metals, pesticides, and industrial chemicals are a concern in many areas. Monitoring must be tuned to local and regional concerns.

Biological Monitoring

In the context of C-GOOS, monitoring of chlorophyll is easily taken as a given. It is conceptually easy to think of monitoring coastal phytoplankton and periodic harmful algal blooms. Also a given is the difficulty of monitoring any other biological variable to an equally comprehensive extent. For example, fisheries data are taken by virtually every fishing nation in the world. In a global sense the FAO annual fisheries statistics are among the most comprehensive biological data even given the variability and the quality control problems. But these data are not used in any way to address concerns of EFH or health of the ocean. Every country in the world takes myriad of specific data for particular concerns encompassing zooplankton, fishes, marine mammals, and sea birds, to name only a few. In some areas of the world, where water clarity makes it possible, key structural elements (sometime key species) of coastal ecosystems (e.g. mangroves, seagrass beds, and reef-building corals) may be monitored by a combination of remote and *in situ* techniques. Trends in these key structural species may be discriminated, hypothetically linked to other variables, and tested over time through adaptive management.

The power of C-GOOS will be to link locally or regionally collected data on unique biological features to the long-term variability of the physical and chemical environment.

2.6 MERGING THE C-GOOS, HOTO AND LMR MODULES

A meeting of the principals from the Health of the Ocean (HOTO), Living Marine Resources (LMR) and C-GOOS panels took place in Washington, D.C. USA, on 17-18 April 2000. The objective of the meeting was to discuss and develop guidelines for the merger of LMR, HOTO and C-GOOS into a single panel for an integrated coastal ocean observing system. Coastal Ocean Observations Panel (COOP) was proposed as the name for the merged panel. A complete report from the merger meeting is available at (http://ioc.unesco.org/goos/COOP_Proposal.rtf).

The initial strategic design plans for each module will have been completed in the second part of 2000. GOOS will then develop through two related and convergent components: (i) a basin scale component concerned primarily with the role of the ocean in the earth's climate system (OOPC) and (ii) a coastal component concerned primarily (but not exclusively) with environmental changes in coastal marine and estuarine ecosystems and their impacts on people (Coastal Ocean Observations Panel). This approach is summarized in *The GOOS 1998 Prospectus*, sections 5.6 and 5.7 (<http://ioc.unesco.org/goos/Prospe98/Contents.html>).

The work of COOP will be complementary and coordinated with that of the Ocean Observing Panel for Climate (OOPC), the primary focus of which is the ocean-climate system. In this context, it should be emphasized that the coastal component of GOOS is not limited by specific geographic boundaries. Coastal ecosystems will be the primary concern of COOP, but many issues related to living marine resources and chemical contamination are not restricted to coastal environments. Thus, boundaries will be determined by the problems being addressed and the products that are to be produced.

It was deemed desirable to have the following areas of expertise represented on the COOP: Fisheries, Biodiversity and Critical Habitat (coral, intertidal wetlands, SAV), Remote Sensing, Hydrodynamic Modelling, Data Assimilation, Ecosystem Modelling, Contamination/Bioeffects, Data and Information Management, Public Health, Harmful Algal Blooms/Toxicity, Coastal Erosion, Natural Hazards/Climate Impacts, Coastal and Physical Oceanography, Biological Oceanography, Chemical Oceanography, Marine Meteorology/Storm Effects, Coastal Zone Management, Biological Indicators/Sensors, and Technology.

One of COOP's key tasks will be to devise mechanisms for interacting with stakeholders, so as to derive information about user requirements. It would be impossible for COOP to interact directly with all user groups, most of which are private entities, national organizations, or multinationals with local (national level) needs. As a start, the Meeting of GOOS Module Chairs suggested three mechanisms for identifying user needs and for consulting users on the emerging GOOS design; other mechanisms may emerge in due course.

Dialog meetings. These are meetings of GOOS representatives with representatives of the user community (a mechanism used by ICES). These would be regional and focused on specific regional interest(s). The organization of such meetings could be the responsibility of interested professional associations (e.g., regional organizations such as PICES or trade associations).

In this regard, it was recommended that consideration should be given to forming a PICES-GOOS group to match the ICES-GOOS group. Action: LMR Chair to discuss the possibility with PICES before LMR meeting, and to bring it up at the third session of the GOOS Steering Committee.

GOOS Forum. Proposed is an annual forum attended by members of COOP and representatives of National GOOS Coordinating Committees (or Steering Committees) and of regional GOOS bodies (e.g., EuroGOOS, NEAR-GOOS, MedGOOS, etc.). These two latter sets of organizations are closest to the user community and are in any case charged with identifying user needs. Thus they represent proxies for broad groups of users.

A critical aspect of the design and implementation of the new COOP module will be the incorporation of user requirements. At the same time, it is clear that it is unrealistic to expect the Panel meet with all users in all regions on a regular basis. This is an important role of national and regional GOOS bodies that have direct linkages to user groups in their country or region. The GOOS Forum will provide one means by which user-needs can be incorporated early in the planning process and a means for continued input as the system develops. The forum will be held annually in conjunction with meetings of the COOP. It will bring together representatives of national and regional GOOS bodies (e.g., Coordinating or Steering Committees) and representatives of key UN 'user' agencies (WMO, UNEP, FAO, IMO, ICSU). In addition to being a vehicle for user input, the forum will also provide an opportunity for national and regional GOOS programmes to coordinate efforts and learn from each other's experiences. This is critical to the development of a global system.

The objectives of the GOOS Forum will be to:

- Regularly communicate user needs to COOP, and COOP developments to users;
- Strengthen the GOOS network through interactions and the trading of information between GOOS bodies;
- Strengthen individual National GOOS Coordinating Committees by exposing them to activities of other nations and regions and by recognizing their central role in assembly of user needs;
- Link the COOP to the national and regional operations of GOOS.

A GOOS Forum will be scheduled in conjunction with the first session of COOP.

3. OUTLINE OF C-GOOS DESIGN PLAN

The main goal of the C-GOOS V meeting was to draft the Strategic Design Plan of the coastal component of GOOS (See Annex 3 in GOOS Report No. 82, C-GOOS IV, for an outline of the document). Much work was completed on the document during intersession, and the status of the document was summarized by Tom Malone. The panel was organized into three working groups to draft the following sections of the plan: (i) Introduction and background sections (chaired by Malone); (ii) The Initial Observing Subsystem (chaired by Thompson); and (iii) The Communications and Data Management Subsystem (chaired by Wang). The working group chairs reviewed the sections and highlighted areas where work would be focused during the working group sessions. Most of the remainder of the panel meeting (2½ days) was devoted to break out sessions in which the three groups worked on drafting these components of the design plan. Each day began and ended with reports from the working group chairs and general discussion in plenary.

4. PRESENTATIONS FROM INVITED EXPERTS

4.1 REMOTE SENSING REQUIREMENTS (Sathyendranath)

Remote sensing by satellite or by aircraft provides the only avenue we have of observing the ocean at synoptic scales. It is important to recognize that the time and space scales that are intrinsic to remote sensing differ significantly from those of *in situ* observations. The instantaneous, large-area views provided by imaging detectors on distant platforms complement *in situ* observations, which are typically more detailed and more precise, but also more local in scope. Thus, satellite data provide the spatial context within which *in situ* observations can be analyzed and interpreted. Remote platforms provide information on surface (or near surface) properties of the coastal environment but do not yield any information on vertical stratification, for which one has to rely entirely on *in situ* observations. In the context of GOOS, it has to be emphasized that remote sensing is the only tool by which one can obtain truly global coverage using the same instrument. This should, under favorable conditions, help with the inter-calibration of some *in situ* observations. It is not envisaged here that remote sensing would be a stand-alone tool, but that it would complement *in situ* observations towards the establishment of an integrated, Global-Ocean Observation System. Remote sensing should also be closely allied with modelling exercises: remotely-sensed data can be used to initialize models of the marine environment, and also to test and validate model results.

A suite of satellites and satellite technologies are currently available for remote sensing of the marine environment. These instruments exploit the properties of various domains of the electromagnetic spectrum. Ocean-color sensors monitor the spectral properties of the water-leaving radiance in the visible domain, which can be analyzed to obtain information on the concentration of chlorophyll-a in the near-surface layers of the ocean. Sensors mounted with detectors in the far infra-red are now used routinely to map information on sea surface temperature (SST). Microwave sensors can be used to detect sea surface height (altimetry), winds at the sea surface (scatterometry) and salinity (microwave radiometers). Synthetic Aperture Radar (SAR) can be used to monitor waves and ice in the ocean. Polar-orbiting satellites with the capability to scan across the satellite track provide global images of the ocean, with typical repeat cycles of a few days. Geostationary satellites with imaging capabilities can be used to monitor cloud cover and its variability in the course of a day, which in turn can be used to derive information on incoming solar radiation at the sea surface. Both visible and infra-red sensors are incapable of seeing through clouds to the ocean surface, and it is only the microwave sensors that can be seen to be “all weather” sensors. Simply masking out the clouded areas in thermal or ocean-color images can lead to serious biases in estimated quantities, and one has to resort to *in situ* observations or to low-flying aircraft to fill in

the gaps in data. The limitations of remote sensing under cloudy conditions are yet another reason why remote and *in situ* observations have to be seen as complementary tools.

Remote sensing of ocean color must play a central role in C-GOOS. For example, ocean color data can be used to estimate phytoplankton biomes (as indexed by the concentration of its main pigment, chlorophyll-a). In turn, the chlorophyll-a concentration, along with information on incoming solar radiation, can be used in models of light penetration and photosynthesis to estimate primary production. Ocean-color data can also be used to monitor some harmful Algal blooms, plumes caused by point source inputs of pollutants, suspended solids, circulation features and the distribution and health of submerged attached vegetation and coral reefs. However, interpretation of ocean-color data in coastal waters is not a simple task. Ocean color (or spectrally-resolved, water-leaving radiance at the sea surface) is a function of the absorption, scattering and fluorescence properties of pure water, dissolved organic material and all particulate matter present in it. It is generally considered that phytoplankton and co-varying substances are the single, major, independent factor responsible for changes in ocean color in the open ocean. Standard algorithms in use today for interpretation of ocean color are designed for application in waters where this condition holds. Most coastal waters, on the other hand, are influenced also by inorganic suspended material and by colored dissolved organic matter, which may be present in high concentrations, and vary independently of phytoplankton. Shallow waters may also be influenced by the optical characteristics of the bottom of the water column. The standard algorithms break down under such conditions. More powerful algorithms are under development (see IOCCG Report No. 3, in preparation), for application in the more complex coastal waters. These algorithms exploit the higher spectral resolution and improved technical capabilities of the current generation of ocean-color sensors, compared with the first ocean-color sensor in space, the Coastal Zone Color Scanner (CZCS). Without a doubt, our ability to extract information from ocean-color data will continue to improve with increasing experience in coastal waters. Similarly, it is understood that interpretation of altimeter data in coastal waters must take into account aliasing of the data by tides: a problem that can be safely ignored when using the same type of data in open-ocean waters. These points illustrate that remote sensing in coastal waters brings with it problems that are unique to the environment, and the success of integrated monitoring programmes such as C-GOOS will depend on keeping pace with new developments in the remote-sensing world. The observational requirements for ocean color measurements in coastal ecosystems (submitted by the IOCCG to the CEOS/WMO Meta Data Base in 2000) are summarized in Table 4.2.4.1-2 (see IOCCG Report No. 3, in preparation).

It would be unrealistic to expect that any single sensor in any given category (visible, infrared or microwave) would be able to meet all the requirements of C-GOOS. For example, the temporal and spatial scales of ocean-color observations have to match those of the applications envisaged (see Table 2, from IOCCG Report No. 3), and one has to be prepared to match sensor with application. Similar arguments would hold for other categories of sensors. It would be advantageous to have many identical sensors in orbit at the same time, but with planned phase lags, for example to overcome (at least partially) the problems with cloud cover, as well as to shorten repeat cycles. This would also eliminate gaps in data, should a satellite die prematurely. One also has to realize that those coastal processes with time and space scales that are totally mismatched with the satellite characteristics are best studied using *in situ* techniques, and that remote sensing cannot be the panacea for all problems.

Another issue in the use of remote sensing for the purposes of long-term monitoring is to ensure uninterrupted flow of ocean-color data into the indefinite future. This is essential to establish and maintain a continuous time-series data set. At present, the flow of ocean-color data beyond the year 2005 is not secure (IOCCG Report No. 2).

Remote sensing is still a young science, and we have not yet learned to exploit it to the full. Before satellite remote sensing reaches its full potential much remains to be done in sensor development, calibration and validation. But it would be always true that the use of remote sensing would be enhanced whenever there is complementary information from other sources. For example there is no simple relationship between ocean color and HABs. Although some types of HABs can be detected by remote sensing (e.g. cyanobacteria in the Baltic Sea or *G. breve* along the US coast), many species are harmful at low concentrations and many blooms concentrate in subsurface layers and cannot therefore be remotely-sensed at present. The use of remote sensing in the study of harmful Algal blooms would be in the study of the growth and areal extent of coastal blooms of phytoplankton. But such studies would always have to be complemented by *in situ* observations to establish the toxicity and vertical stratification of the blooms. Our ability to distinguish between groups of phytoplankton by remote sensing is expected to improve with technology, but it would not be reasonable to expect that it would ever parallel what can be achieved in the field.

In 1999, the IGOS Partnership established a thematic approach to the implementation of the Integrated Global Observing Strategy. The "Oceans Theme" was selected to initiate the process with remote sensing as the primary focus. Remote sensing capabilities are considered in two categories: (i) those for which the challenge is to sustain a long-term commitment to continued measurements and (ii) those for which the challenge is to develop the knowledge base or technology required to justify such a long-term commitment. Most of the satellite measurements required to characterize the physical environment of the surface ocean fall into the first category including scatterometry for surface winds, altimetry for ocean surface topography, radiometry for sea surface temperature and sea ice.

Table 2. Examples application areas of coastal ocean-color data, requirements for spatial resolution and extent, temporal resolution, and examples of current or planned platforms and sensors meeting those requirements. From IOCCG Report No. 3. Additional details about the instruments can be found in IOCCG Reports No. 1 and 2.

Applications / Issues	Spatial Resolution x Extent	Temporal Resolution	Examples of suitable platforms / sensors
River plumes, outfalls	(30 m – 1 km) x (300 m – 100 km)	hours - weeks	NEMO, MERIS, SeaWiFS, GLI
Tidal plumes, jets, frontal dynamics	(100 m – 1 km) x (1 km – 10 km)	Hours	Airborne, SEI
Harmful Algal blooms, aquaculture, coastal water quality	(100 m – 1 km) x (1 km – 100 km)	days - weeks	NEMO, MERIS, SeaWiFS, GLI MODIS
Bathymetry and shallow benthic habitat: distribution, status	(1 m – 30 m) x (1 km – 100 km)	weeks to months	Airborne platforms, NEMO, ARIES
Maritime operations: navigation, visibility	(30 m – 1 km) x (30 km – 100 km)	Hours to days	NEMO, MERIS, SeaWiFS
Oil spills	(100 m – 1 km) x (1 km – 100 km)	Hours - days	Airborne, SEI MODIS, MERIS
Operational fisheries oceanography	1 km x 1000 km	Days	SeaWiFS, GLI MODIS, MERIS
Integrated regional management	(30 m – 300 m) x (30 km – 300 km)	Days	NEMO, MERIS

Measurements from remote sensing that are particularly important to C-GOOS and that fall into the second category are sea surface salinity and ocean color. Salinity is an important tracer of freshwater inputs from land and is an important tracer of coastal circulation. Ocean color provides

important data to (i) quantify carbon flux, (ii) couple physical and ecosystem models of the surface layer, and (iii) manage water quality and fisheries. These applications for coastal ecosystems impose demanding requirements on ocean-color sensors in terms of spatial and temporal scales of measurement, spectral resolution and signal-to-noise ratio. Most proposed coastal ocean color products for coastal waters are experimental, and algorithm developments have depended to a large extent on *in situ* and air-borne experiments. A scenario for meeting all of the requirements for ocean-color measurements (high spatial, temporal, and spectral resolution for measurements of chlorophyll-a and suspended sediments) in coastal waters has not been developed. This may begin to change with the launch of the Medium Resolution Imaging Spectrometer (MERIS). However, if an operational ocean-color programme is to be based on a minimum number of dedicated sensors for complete and repetitive coverage, current applications for coastal waters will be limited to the detection of high suspended sediment loads and the optical thickness and character of aerosols near the air-sea interface.

A multi-decadal time series of biological and chemical properties in coastal waters is needed to provide the observational basis for understanding and predicting change in coastal ecosystems. The development of ocean-color science and technology, with its ability to monitor a range of indicators over a wide range of scales, is critical to the successful development of C-GOOS. The European Union has established directives which require monitoring water quality indicators in coastal waters including transparency, color, and suspended solids. Ocean color sensors offer the potential of standard, cost-effective means to monitor compliance. Although the costs of sensors, satellite deployment, and algorithm development are high, the marginal costs of remotely-sensed products are low, and many global and regional products are distributed virtually free. Thus, remotely-sensed products will, in the long run, be cost-effective for environmental monitoring. This will be especially important for developing countries.

Experimental satellites and missions (e.g. GRACE, WITTEX) planned for the next decade will provide an opportunity to develop and test algorithms, models and management strategies. However, in the long run, the success of coastal management programmes will depend on the development of sustained, long-term data sets. The importance of long-term continuity has been recognized by the space agencies and the ocean-color community (IOCCG, 1998; 1999).

4.2 BATHYMETRIC REQUIREMENTS (Beach)

Improving the robustness of operational 3D model products is of high priority. It is obtained through a synthesis of knowledge and experience with the prediction systems. The knowledge gaps sets the research and development priorities. Improvements of existing models are largely expected to be obtained through improved boundary conditions. For the coastal ocean, basin scale atmosphere and ocean boundary conditions are generally available. However, bathymetry is not as readily available, and it is of first order importance in improving model products.

Traditional ship-based hydrographic surveying/bathymetry collection is rather slow and expensive. Moreover a refinement of a modelling domain's bathymetry may require collaboration from neighbouring states in order to achieve a complete spatial coverage of the modelling terrain. The US Naval Oceanographic Office (USN NAVO) offers nations, through its Cooperative Survey Programme, assistance with hydrographic data collection either through deployment of a USN NAVO ship or through loan of surveying equipment in their coastal zone. More information about the programme can be obtained from Dr. Bob Bullard, +44.181.385.5425 (tel), +44.181.385.5427 (fax) or e-mail: bullardr@navo.navy.mil). The French and UK naval oceanographic offices offer similar programmes.

4.3 MEDITERRANEAN FORECASTING SYSTEM (MFS) (Pinardi)

In 1995 the EuroGOOS Scientific Steering Group decided to start a Mediterranean Test Case Task Team (EMTT) to elaborate the overall strategy for scientific research toward Operational Oceanography in the Mediterranean Sea. In September 1998 a project called MFS (Mediterranean Forecasting System) started with the MFS Pilot Project (MFSPP), funded by the Marine Science and Technology Programme (MAST) of the European Union.

The forecasting system is based upon a Near Real Time basin wide observing system started by the Project itself. There are seven Voluntary Observing Ship (VOS) tracks occupied twice a month to provide temperature profiles down to 700 metres. Data are sent through satellite connection to Global Telecommunication System (GTS) stations and thus they also enter the global ocean temperature data set. By Internet communication, satellite Topex/Poseidon sea surface height along track data, weekly satellite sea surface temperatures are dispatched once a week to the modelling and forecasting centre. In addition, a new open ocean buoy system, called Mediterranean Multisensor Moored Array (M3A), has also been implemented which collects data in near real time and will make the data available through the Web soon. Furthermore, satellite chlorophyll deduced from ocean color data, is also available.

The scientific objectives to explore, model and quantify the potential predictability of the marine ecosystem at the level of primary producers from the overall basin to the coastal areas and for the time scale of weeks to months and the operational objective was to test the feasibility of the required observing and the modelling systems, and the timeliness of the MFSPP products. The project aims at developing and implementing:

- A pilot automatic temperature monitoring system for the overall Mediterranean Sea (VOS system) with NRT data delivery;
- A pilot Mediterranean Multisensor Moored Array buoy system (M3A) which could automatically monitor a complete set of physical parameters, such as temperature, salinity and currents, together with relevant bio-geo-chemical and optical measurements in order to establish the feasibility of multiparametric monitoring of the upper thermocline in the whole basin;
- NRT satellite data (sea surface height, sea surface temperature and color) analysis and mapping on the numerical model grid;
- Different data assimilation schemes in order to assimilate multivariate parameters, e.g., XBT from the VOS system and satellite sea surface height and sea surface temperature;
- A strategy to carry out 3, 5 and 10 days ocean forecast experiments at the whole basin scale and for a total period of three months ;
- Techniques to downscale the hydrodynamics to different shelf areas of the Mediterranean Sea with nested models of different resolution;
- Ecosystem models in shelf areas of the basin and a strategy for validation/calibration with M3A data sets;
- Methods for assimilating nutrient, chlorophyll and PAR into predictive ecosystem models ;

- Realize an overall NRT data collection and dissemination network, which should allow the timeliness release of data for the forecasting exercise.

Some of the MFSPP Products are Near Real Time VOS XBT observation charts, Near Real Time Sea Level Anomaly, Sea Surface Temperature, Chlorophyll maps, Near Real Time Mediterranean Moored Multi-sensor Array (M3A) data, and Model hindcasts and forecast at basin scale Regional models simulations for perpetual year conditions. 1-, 3-, 5- and 10-day forecasts of Temperature, Salinity, Currents at various depths, Depth of Mixed Layer, Water Mass Formation Rates and Strait Volume Transport are made available weekly.

The developments of the MFS will be implemented in three phases over a time span of about 10 years. Phase one started in 1998 and is expected to end in 2001. During that time the observing system backbone has been established. VOS-XBT data collection has been carried out since September 1999 and a moored buoy M3A test site has been established. Trial forecast experiments are going on at basin scales. Calibration and validation of regional/coastal hydrodynamic and ecosystem models are ongoing.

4.4 BOOS (Buch)

The Baltic Operational Oceanographic System (BOOS) constitutes a regional Task Team under the European component of the Global Ocean Observing System - EuroGOOS. BOOS was described in detail at the C-GOOS IV (GOOS Report No. 82). An update was provided on developments since the C-GOOS IV meeting. Some of the highlights were:

- The BOOS implementation plan for 1999-2003 has been published (<http://www.soc.soton.ac.uk/OTHERS/EUROGOOS/Activities/ActivitiesFrameSet.html>);
- A data policy for the exchange of operational data has been agreed upon in EuroGOOS. This is paving the way for the first joint operational data products. One example being a near real-time map of sea-level observations, which Denmark and Sweden already contribute to and which Germany, Poland and Finland also would be linked into (<http://www.dmi.dk/vejrvandstand/boos.html>);
- Monthly nutrient maps will be produced for the Helsinki Convention (Baltic Marine Environment Protection Commission).

4.5 GLOBAL CORAL REEF MONITORING NETWORK (Wilkinson)

The Global Coral Reef Monitoring Network and Reef Check operate as the research and monitoring arm of the International Coral Reef Initiative (ICRI). The GCRMN was initiated in 1995 with a grant from the US State Department as a contribution at the ICRI International Meeting in Dumaguete City, the Philippines in May-June 1995. A Co-ordinator was appointed in 1996 by IOC acting as the primary sponsor with UNEP and IUCN as the other co-sponsors. The World Bank joined as a co-sponsor in 1998. Reef Check started in 1997 as an initiative of Gregor Hodgson of the Hong Kong University of Science and Technology. They released their first global report in 1998 and have just released the 1999 report. Their funding is based on many small foundations and similar sources, along with a large component of in-kind support from participants and tourist operators.

GCRMN was set up to operate primarily through government agencies while Reef Check was designed to operate mainly through non-governmental organizations (NGOs) or community groups. The methods promoted by GCRMN are more detailed, with medium to high resolution suitable for intensive government monitoring efforts, where sufficient expertise is available. In contrast, the Reef Check methods were specifically designed to be used by non-scientists, hence are suitable for community groups. Thus the two programmes complement each other and are more cost-effective by allowing the sharing of coordinators, training and survey data. All survey data have been and will continue to be supplied to the global coral reef database, ReefBase at the International Centre for Living Aquatic Resources Management (ICLARM) in Manila.

The joint goals of GCRMN and Reef Check are to:

- Establish a global network of monitoring teams that links all countries with coral reefs, and provides them with the training and tools needed to monitor (biophysical and socioeconomic parameters) and manage their reefs at the local and national levels;
- Raise the awareness of governments and the public about the value of coral reefs, threats to their health and solutions to these problems;
- Build a sense of stewardship among coastal communities and the general public regarding coral reefs;
- Produce a globally comparable database on coral reefs that is updated annually, and allows the tracking of regional and global problems, such as global warming; and
- Feed the data and information into global assessment systems especially GOOS and the Millennium Ecosystem Assessment.

The critical need was to establish some monitoring in countries with limited or no expertise (most countries), by implementing the most basic level with initial Reef Check training for all teams. As government monitoring teams gain experience, they will receive advanced training in higher resolution methods drawn from a menu available from GCRMN. Most community-based groups (fishermen, villagers, recreational divers, military, etc.) will continue to use Reef Check methods, with many sites monitored by community groups using the low taxonomic resolution (Reef Check) methods, and fewer sites monitored by government staff using high resolution methods. This combination of two (or more) monitoring levels has proven to be very effective in both developing and developed countries where it already is being tested.

Both GCRMN and Reef Check encourage the third critical level of monitoring – that are carried out by scientists and major institutions. These are at a higher level and usually designed around answering specific questions. This level is critical for establishing the quality control of monitoring data obtained during the other levels and also for forming the essential centres of excellence in monitoring that are used to train and coordinate the GCRMN and Reef Check monitoring. This level of monitoring is generally anarchic and scientists do not respond well to attempts at coordination and control.

The GCRMN published its first Status of Coral Reefs of the World: 1998 report for distribution at the International Tropical Marine Ecosystems Management Symposium in Townsville in late November. That report summarized global coral bleaching using data collected by Reef Check and the GCRMN, and information provided by many people who replied to e-mail requests via coral_list. The next report is scheduled for release at the 9th International Coral Reef Symposium in Bali, October 2000. Reef Check produces annual reports accompanied by an active media campaign to raise awareness of the plight of coral reefs.

The primary task of both networks is to expand the monitoring network to a reasonable baseline level in all countries with coral reefs and then gradually raise the capacity of these countries to perform monitoring at a more enhanced level.

The lessons that have been learned during this process and which may be applicable for GOOS monitoring are as follows:

- It is essential to combine natural science monitoring with a socioeconomic component. Funding sources are more inclined to support monitoring if there is a human component, e.g. the goal of alleviating poverty by conserving natural resources;
- Produce some products early. Donors are wary of projects that have long time schedules without interim products, but are encouraged if products come out regularly. Moreover the people involved retain a better focus if there is a need to report regularly. An example for GOOS could be lists and contact points for the existing monitoring components and summaries of their past findings, possibly accentuating the gaps;
- Produce products based on predictions. Many scientists are nervous of attempting predictions, however decision makers demand best-guess information on which to act. Predictions can contain caveats – this will happen unless urgent measures are implemented to control xyz factors;
- Pilot projects can function at different levels to allow for differing capacities in countries. It is essential to get some people started at a low level without the expectation that high quality, statistically reliable data will be gathered from day 1;
- Put the focus on the summary data and information, not on methods. Scientists are particularly sensitive about the methods they use and may consider any suggestion of changes as a threat to their integrity. Much energy can be saved by focussing on comparing results at temporal scales at the same site, and extrapolating this to the large scale, rather than trying to compare ecosystems in different parts of the world;
- Accept all data offered and then provide encouragement to improve data quality and frequency. Too much emphasis on quality early can discourage less experienced people and countries;
- Data ownership is critical to many people, therefore the emphasis should be on allowing researchers and countries to retain their primary data but share summary data for regional and global reporting. Eventually the possessive attitudes about data ownership will dissipate, and a greater sense of sharing will eventuate;
- Comparisons at one site over time are the most valuable and with the potential for statistical rigor; comparisons at regional and global scales are less important scientifically, but often of great importance for decision makers. These latter comparisons can be more general in nature and focus on information and predictions, rather than data;
- Many countries are not on reliable phone and data lines, therefore over emphasis on electronic distribution will exclude them. Moreover, many people in senior decision making positions are nervous about demonstrating their lack of ability in front of a computer. Therefore, ensure that information is distributed in several ways and reduce the emphasis on complicated web pages with large amounts of graphic material (these take ages to download on poor lines and then are of minimal value, compared to the words and numbers).

4.6 RAMSAR CONVENTION (Davidson)

The Convention on Wetlands is an intergovernmental treaty adopted on 2 February 1971 in the Iranian city of Ramsar, on the southern shore of the Caspian Sea. Thus, though nowadays the name of the Convention is usually written "Convention on Wetlands (Ramsar, Iran, 1971)", it has come to be known popularly as the "Ramsar Convention". Ramsar is the first of the modern global intergovernmental treaties on conservation and wise use of natural resources, but, compared with

more recent ones, its provisions are relatively straightforward and general. Over the years, the Conference of the Contracting Parties (the main decision-making body of the Convention, composed of delegates from all the Member States) has further developed and interpreted the basic tenets of the treaty text and succeeded in keeping the work of the Convention abreast of changing world perceptions, priorities, and trends in environmental thinking.

The official name of the treaty – The Convention on Wetlands of International Importance especially as Waterfowl Habitat – reflects its original emphasis on the conservation and wise use of wetlands primarily to provide habitat for waterbirds. Over the years, however, the Convention has broadened its scope to cover all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well-being of human communities. For this reason, the increasingly common use of the short form of the treaty's title, the "Convention on Wetlands", is entirely appropriate.

The Convention entered into force in 1975 and as of 1 February 2000 has 118 Contracting Parties.

Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by shallow water.

The Ramsar Convention takes a broad approach in determining the wetlands which come under its aegis. Under the text of the Convention (Article 1.1), wetlands are defined as:

"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres".

In addition, the Convention (Article 2.1) provides that wetlands:

"may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands".

As a result of these provisions, the coverage of the Convention extends to a wide variety of habitat types, including rivers and lakes, coastal lagoons, mangroves, peatlands, and even coral reefs.

In addition there are human-made wetlands such as fish and shrimp ponds, farm ponds, irrigated agricultural land, salt pans, reservoirs, gravel pits, sewage farms, and canals.

Wetlands occur in every country, from the tundra to the tropics. How much of the earth's surface is presently composed of wetlands is not known exactly. The World Conservation Monitoring Centre has suggested an estimate of about 570 million hectares (5.7 million km²) – roughly 6% of the Earth's land surface – of which 2% are lakes, 30% bogs, 26% fens, 20% swamps, and 15% floodplains. Mangroves cover some 240,000 km² of coastal area, and an estimated 600,000 km² of coral reefs remain worldwide. Nevertheless, a global review of wetland resources submitted to the Conference of the Parties to the Convention on Wetlands in 1999, while affirming that *"it is not possible to provide an acceptable figure of the areal extent of wetlands at a global scale"*, indicated a 'best' minimum global estimate at between 748 and 778 million hectares. The same report indicated that this "minimum" could be increased to a total of between 999 and 4,462 million hectares when other sources of information were taken into account.

More than 1000 wetlands have been designated for inclusion in the List of Wetlands of International Importance, covering some 73 million hectares.

UNESCO serves as Depositary for the Convention, but its administration has been entrusted to a secretariat known as the "Ramsar Bureau", which is housed in the headquarters of The World Conservation Union (IUCN) in Gland, Switzerland, under the authority of the Conference of the Parties and the Standing Committee of the Convention.

The Convention has published a series of nine Ramsar Handbooks presenting the guidelines adopted by the Conference of the Parties over the years in the areas of: wise use of wetlands; national wetland policies; laws and institutions; wetlands and river basin management; community participation; education and public awareness; development of the Ramsar List; management planning; and international cooperation. More information about the Ramsar Convention can be found at (www.ramsar.org).

5. OTHER BUSINESS

The timetable for finishing up the design plan was discussed. It was agreed that a drafting group consisting of Julie Hall, Tom Malone and Keith Thompson would complete the design plan so it could be sent out for external review by early August 2000. Reviews would be gathered during August and September 2000. A revised design plan should be ready in early October 2000 well in advance of the first meeting of COOP.

In closing Tom Malone expressed his most sincere thanks to all the panel members and experts who had participated in the C-GOOS design process. On behalf of the IOC Executive Secretary, Thorkild Aarup thanked all the panel members and the experts who had been involved in the C-GOOS design process for their hard work and good collaboration.

ANNEX I

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II. REPRESENTATIVES OF OTHER OBSERVING SYSTEMS AND SPONSORS

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ANNEX II

AGENDA

2 May - Stakeholder Workshop

3 May - Day 1 of C-GOOS V (08:30 - 17:30)

PLENARY

1. Opening (Namiesnik); Logistics (Pacyna, Aarup); Designate rapporteur, Goal of meeting & working group assignments (Malone)

2. Panel Member Reports

- 2.1 International Coastal Symposium (Hall)
- 2.2 LOICZ Science Meeting (Marone)
- 2.3 GOOS Capacity Building: Implementation Plan (Marone)
- 2.4 EuroGOOS: Ecological observations in operational oceanography (Zingone)
- 2.5 Ad hoc Habitat Committee (Malone)
- 2.6 Meeting of the Chairs: C-GOOS/HOTO/LMR (Malone)

3. The C-GOOS Design Plan

- 3.1 Brief review of document and rationale for how it is organized (Malone)
- 3.2 Detailed discussion of the parts (What needs to be done?)
 - 3.2.1 Prologue, Goals, Background, The Challenge (Malone)
 - 3.2.2 The Initial Observing Subsystem (Thompson)
 - 3.2.4 Communications and Data Management Subsystem (Hong Wang)

WORKING SESSION I

4. Working Groups (Develop procedures to complete drafts by end of day 3; writing assignments; assemble background material and begin writing if time)

WG 1 - Malone, Chair: Executive Summary, Prologue, Introductory sections 1, 2, & 3

WG 2 - Thompson, Chair: 4.1. Framework, 4.2 Model Development and Applications, 4.3 The Initial Observing Subsystem

WG 3 - Hong Wang, Chair: Communications Network & Data Management Subsystem

4 May - Day 2 (08:30 - 17:30)

PLENARY

5. C-GOOS Requirements (30 min each)

- 5.1 Remote sensing requirements (Sathyendranath)
- 5.2 Bathymetric requirements (Beach)
- 5.3 MFS (Pinardi)
- 5.4 BOOS: Data management, user groups and products (Buch)
- 5.5 GCRMN (Wilkinson)
- 5.6 Ramsar Convention on Wetlands (Davidson)

WORKING SESSION I (continued)

6. Working Groups

5 May - Day 3 (08:30 - 17:30)

PLENARY

7. Working Group Reports

- 7.1 WG 1: Executive Summary, Introductory Sections 1, 2 & 3 (Malone)
- 7.2 WG-2: Sections 4.1, 4.2, & 4.3 The Initial Observing Subsystem (Thompson)
- 7.3 WG-3: Communications Network & Data Management Subsystem (Hong Wang)

WORKING SESSION I (continued)

8. Working Groups 1, 2 and 3 (complete sections 1, 2, 3, and 4)

PLENARY

9. Reports of Working Group Chairs

- 10. Review & agree on outline for Section 5. Conclusions & Recommendations - New WGs

WORKING SESSION II

11. Working Groups (Develop outlines & writing assignments for each part of section 5)

6 May - Day 4 (08:30 - 17:30)

PLENARY (Brief)

12. Reports from Working Group Chairs

WORKING SESSION (II)

PLENARY

- 13. Reports from WG Chairs and discussion; final writing assignments
- 14. Compile list of external reviewers

ADJOURN

ANNEX III

LIST OF ACRONYMS

ARIES	Australian Resource Information and Environment Satellite
BOOS	Baltic Operational Oceanographic System
C-GOOS	Coastal Panel of GOOS
CEOS	Committee on Earth Observation Satellites
COOP	Coastal Ocean Observations Panel
CZCS	Coastal Zone Color Scanner
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EMTT	Mediterranean Test Case Task Team
EU	European Union
EuroGOOS	European GOOS
FAO	Food and Agriculture Organisation
GCRMN	Global Coral Reef Monitoring Network
GLI	Global Imager
GOOS	Global Ocean Observing System
GRACE	Gravity and Climate Recovery Experiment
GSC	GOOS Steering Committee
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunication System
HAB	Harmful Algal Bloom
HELCOM	Baltic Marine Environment Protection Commission
HOTO	Health of the Oceans
ICES	International Council for the Exploitation of the Sea
ICLARM	International Center for Living Aquatic Resources Management
ICRI	International Coral Reef Initiative
ICSU	International Council for Science
IGOS	Integrated Global Observing Strategy
IMO	International Maritime Organisation
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IOCCG	International Ocean-Colour Coordinating Group
IPHAB	Intergovernmental Panel on Harmful Algal Blooms
IUCN	World Conservation Union
LMR	Living Marine Resources
LOC	Local Organising Committee
LOIRA	Land-Ocean Interactions in the Russian Arctic
LOICZ	Land-Ocean Interactions in the Coastal Zone
MAST	Marine Science and Technology Programme (European Union)
MedGOOS	Mediterranean GOOS
MERIS	Medium Resolution Imaging Spectrometer
MFS	Mediterranean Forecasting System
MFSP	Mediterranean Pilot Project
MODIS	Moderate Resolution Imaging Spectroradiometer
MPA	Margin Protected Areas
M3A	Mediterranean Multisensor Moored Array
NEMO	Naval Earth Map Observer (US Navy)
NGOs	Non-governmental Organisations
NEAR-GOOS	North East Asian GOOS

NOAA	National Oceanic and Atmospheric Administration (USA)
OOPC	Ocean Observations Panel for Climate
PICES	North Pacific Marine Sciences Organisation
SAR	Synthetic Aperture Radar
SCOR	Scientific Committee on Oceanic Research
SeaWIFS	Sea-Viewing Wide Field-of-View Sensor
SEI	Special Events Imager
SST	Sea Surface Temperature
TEMA	Training, Education and Mutual Awareness (of IOC)
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Cultural and Scientific Organisation
VOS	Voluntary Observing Ships
WITTEX	Water Inclination Topography and Technology Experiment
WMO	World Meteorological Organisation
WOCE	World Ocean Circulation Experiment
XBT	Expendable Bathythermograph

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans S. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (**Also printed in Spanish**)
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping (**Also printed in French and Spanish**)
12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica (**Spanish only**)
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources (**Also printed in French and Spanish**)
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (**Also printed in French**)
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities (**Also printed in Spanish**)
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CCPS Working Group on the Investigations of 'El Niño' (**Also printed in Spanish**)
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN(OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic (**Also printed in French**)
54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (**Also printed in Spanish**)
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping

59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans (**Also printed in French**)
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (**Spanish only**)
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (**Also printed in Spanish**)
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
79. Third Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
81. Fifth Joint IOG-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth Session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO₂ Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
96. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System
97. Joint Meeting of GEMSI and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA *Ad hoc* Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
108. Third Session of the Health of the Oceans (HOTO) Panel of the Joint Scientific and Technical Committee for GLOSS
109. Second Session of the Strategy Subcommittee (SSC) of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System
110. Third Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
111. First Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate
112. Sixth Session of the Joint IOC-JGOFS CO₂ Advisory Panel Meeting
113. First Meeting of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS)
114. Eighth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Niño" (**Spanish only**)
116. Second Session of the IOC Editorial Board of the International Bathymetric Chart of the Central Eastern Atlantic (**Also printed in French**)
116. Tenth Session of the Off ices Committee for the Joint IOC-IHO General Bathymetric Chart of the Oceans (GEBCO), USA, 1996
117. IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Fifth Session, USA, 1997
118. Joint Scientific Technical Committee for Global Ocean Observing System (J-GOOS), Fourth Session, USA, 1997
199. First Session of the Joint 100-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel, South Africa, 1997
120. Report of Ocean Climate Time-Series Workshop, Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, USA, 1997

121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997
122. First Session of the IOC-IUCN-NOAA *Ad hoc* Consultative Meeting on Large Marine Ecosystems (LME), France, 1997
123. Second Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), South Africa, 1997
124. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico, Colombia, 1996 (**also printed in Spanish**)
125. Seventh Session of the IODE Group of Experts on Technical Aspects of Data Exchange, Ireland, 1997
126. IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), First Session, France, 1997
127. Second Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 1998
128. Sixth Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1997
129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997
130. First Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 1998
131. Fourth Session of the Health of the Oceans (HOTO) Panel of the Global Ocean Observing System (GOOS), Singapore, 1997
132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997
133. First Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1998
134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWIO-IW3), South Africa, 1997
135. Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), France, 1998
136. Seventh Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Germany, 1997
137. Implementation of Global Ocean Observations for GOOS/GCOS, First Session, Australia, 1998
138. Implementation of Global Ocean Observations for GOOS/GCOS, Second Session, France, 1998
139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998
140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998
141. Ninth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Ecuador, 1998 (**Spanish only**)
142. Seventh Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Croatia, 1998
143. Seventh Session of the Tropical Atmosphere-Ocean Array (TAO) Implementation Panel, Abidjan, Côte d'Ivoire, 1998
144. Sixth Session of the IODE Group of Experts on Marine Information Management (GEMIM), USA, 1999
145. Second Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), China, 1999
146. Third Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999
147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999
148. Second Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1999
149. Eighth Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Japan, 1999
150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999
151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999
152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 1999
153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999
154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Septima Reunión, Mexico, 1998
IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998
155. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Impl-III/3, France, 1999
156. First Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 (**also printed in Spanish**)
157. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999
158. Eighth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Russian Federation, 1999
159. Third Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Chile, 1999
160. Fourth Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS). Hawaii, 2000
161. Eighth Session of the IODE Group of Experts on Technical Aspects of Data Exchange, USA, 2000
162. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000
163. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000